



UNITED STATES  
CONSUMER PRODUCT SAFETY COMMISSION  
WASHINGTON, DC 20207

Memorandum

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SUBJECT : 2005 Annual Report of All-Terrain Vehicle (ATV)-Related Deaths and Injuries

Attached is the annual report of ATV-related deaths and injuries for the year 2005. This report covers death data available as of December 31, 2005, and data on injuries occurring up to December 31, 2005.

Attachment (1)

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## 2005 Annual Report of ATV Deaths and Injuries

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[REDACTED]

November 2006

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## **Introduction**

U.S. Consumer Product Safety Commission (CPSC) staff first began analyzing data on all-terrain vehicles (ATVs) in the early 1980s as a means to provide statistics on the numbers of deaths and injuries associated with three-wheel ATVs. In April of 1988, CPSC entered into consent decrees with five ATV distributors in which they agreed, among other things, to halt production of three-wheelers, offer safety training to all new ATV owners, and recommend adult-sized ATVs only for those aged 16 and older. Those decrees expired in April of 1998. Following their expiration, the five distributors and two others have agreed to continue most of the elements of the consent decrees through voluntary action plans. In addition, on June 28, 2006, the Commission voted to issue a Notice of Proposed Rulemaking on all-terrain vehicles that would make mandatory many of the provisions in the voluntary action plans. The Commission also proposed to formally ban the manufacture and distribution of three-wheel ATVs. Some older three-wheel ATVs survive in use by consumers, but nearly all vehicles on the market today are four-wheelers.

This report provides an update of CPSC data on ATV deaths and injuries. This update includes death reports available as of December 31, 2005, and data on injuries occurring up to and including December 31, 2005.

## **Deaths Reported to the Commission**

On December 31, 2005, the Commission had reports of 7,188 ATV-related deaths that have occurred since 1982 (Table 1). The number of new reports increased by 694 since the December 31, 2004 tabulation reported by Commission staff in September 2005. The new reports include deaths occurring over the period 1999 to 2005 inclusive. Data collection for 2002 through 2005 is ongoing. Consequently, the numbers of reported deaths for 2002 through 2005 are expected to rise before the next annual report.

Values above the heavy line in Table 1 reflect a revised classification system from the one used prior to 1999. Specifically, the line marks the switch from data collection under the Ninth Revision of the International Classification of Diseases (ICD-9) to collection under the Tenth Revision (ICD-10), a transition that occurred worldwide in January of 1999. Any comparison of numbers above and below the line should be undertaken with caution. The ICD-10 transition and related methodological issues are discussed more fully in Appendix B.

Table 2 gives the numbers of reported ATV-related deaths for each state, the District of Columbia and Puerto Rico. Deaths occurring in the period 1982 through 2001 are tabulated in the second column and allow for the comparable ranking of states. The years 1982 to 2001 constitute the period for which death report collection is complete. The highest numbers of deaths occurring in the complete period were for California (297 deaths), Pennsylvania (274), Texas (221), Michigan (210), and New York (207). Together these five states accounted for 24 percent of all reported deaths in the U.S., as shown in column three.

Counts of deaths reported as of December 31, 2005 in each state for the period 2002-2005 are tabulated in the fourth column of Table 2. This tabulation of deaths reported in these years cannot be used for comparisons among states because data collection in some states is more complete than in other states for those years. Each state's total number of reported deaths is listed in the fifth column.

**Table 1**  
**Reported ATV-Related Deaths by Year**  
**ATVs with 3, 4 or Unknown Number of Wheels**  
**January 1, 1982 to December 31, 2005**

<b>Year<sup>1</sup></b>	<b>Number of Deaths</b>	<b>Difference Since Last Update (12/31/2004)</b>
<b>Total</b>	<b>7,188</b>	<b>+694</b>
<i>2005</i>	<i>467</i>	<i>+467</i>
<i>2004</i>	<i>609</i>	<i>+139</i>
<i>2003</i>	<i>636</i>	<i>+67</i>
<i>2002</i>	<i>540</i>	<i>+8</i>
<i>2001</i>	<i>517</i>	<i>+12</i>
<i>2000</i>	<i>451</i>	<i>+2</i>
<i>1999<sup>2</sup></i>	<i>398</i>	<i>-1</i>
1998	251	0
1997	241	0
1996	248	0
1995	200	0
1994	198	0
1993	183	0
1992	221	0
1991	230	0
1990	234	0
1989	230	0
1988	250	0
1987	264	0
1986	299	0
1985	251	0
1984	156	0
1983	85	0
1982	29	0

Source: U.S. Consumer Product Safety Commission, Directorate for Epidemiology, Division of Hazard Analysis.  
Italics denote the period for which reporting is incomplete.

<sup>1</sup> Reporting is incomplete for 2002-2005.

<sup>2</sup> Beginning in 1999, deaths were coded under the Tenth Revision of the International Classification of Diseases (ICD-10). See Appendix B for an explanation of the effect of this change.

**Table 2**  
**Deaths Associated With ATVs by State**  
**ATVs with 3, 4 or Unknown Number of Wheels**  
**Reported for the Period January 1, 1982 Through December 31, 2005**

State	Reported Deaths 1982-2001	Cumulative Percent of U.S. 1982-2001	Reported Deaths 2002-2005*	Total Reported Deaths*
CALIFORNIA	297	6%	76	373
PENNSYLVANIA	274	12	120	394
TEXAS	221	16	87	308
MICHIGAN	210	20	70	280
NEW YORK	207	24	77	284
WEST VIRGINIA	197	28	138	335
TENNESSEE	189	32	94	283
FLORIDA	185	36	110	295
KENTUCKY	183	40	143	326
NORTH CAROLINA	172	43	103	275
ARKANSAS	159	46	26	185
MISSISSIPPI	156	50	51	207
GEORGIA	148	53	81	229
OHIO	144	56	59	203
WISCONSIN	140	58	58	198
MINNESOTA	135	61	61	196
MISSOURI	133	64	78	211
ALABAMA	116	66	35	151
LOUISIANA	114	68	38	152
ARIZONA	108	71	39	147
ILLINOIS	108	73	41	149
UTAH	89	75	25	114
VIRGINIA	89	76	48	137
INDIANA	86	78	52	138
ALASKA	85	80	18	103
OREGON	82	82	37	119
OKLAHOMA	70	83	39	109
MAINE	66	84	30	96
IOWA	65	86	31	96
KANSAS	65	87	27	92
IDAHO	57	88	32	89
COLORADO	54	89	39	93
NEW MEXICO	50	90	26	76
WASHINGTON	49	91	29	78
NEBRASKA	46	93	37	83
SOUTH CAROLINA	46	92	17	63
MASSACHUSETTS	41	94	13	54
NEW HAMPSHIRE	37	95	16	53
NEW JERSEY	36	95	18	54
VERMONT	36	96	7	42
NEVADA	32	97	18	50
MARYLAND	29	97	24	53
SOUTH DAKOTA	29	98	13	42
NORTH DAKOTA	27	98	13	40
MONTANA	26	99	17	43
CONNECTICUT	18	99	12	30
WYOMING	15	100	16	31
DELAWARE	5	100	2	7
DISTRICT OF COLUMBIA	3	100	2	5
HAWAII	3	100	1	4
RHODE ISLAND	3	100	8	11
PUERTO RICO	2	100	0	2

Source: U.S. Consumer Product Safety Commission, Directorate for Epidemiology, Division of Hazard Analysis.

Italics denote the period for which reporting is incomplete. State ranking based on complete reporting period only.

\*Data collection for 2002-2005 is incomplete. Columns 4 and 5 should not be used for comparison among states.

### **Characteristics of ATVs and Fatalities**

A review of the reported fatalities indicated that 2,178 victims (30 percent of the 7,188 total) were under 16 years of age and 917 (13 percent of the total) were under 12 years of age. Table 3 gives the numbers and percentages of reported fatalities by year for individuals younger than 16 years of age. Appendix A contains a more detailed breakdown of numbers of reported deaths in this age group.

**Table 3**  
**Reported ATV-Related Deaths of Children Younger Than 16 Years Old**  
**ATVs with 3, 4 or Unknown Number of Wheels**  
**January 1, 1982 to December 31, 2005**

<b>Year<sup>3</sup></b>	<b>Younger Than 16</b>	<b>Younger Than 16 Percent of Total</b>
<b>Total</b>	<b>2,178</b>	<b>30%</b>
<i>2005</i>	<i>120</i>	<i>26</i>
<i>2004</i>	<i>155</i>	<i>25</i>
<i>2003</i>	<i>152</i>	<i>24</i>
<i>2002</i>	<i>133</i>	<i>25</i>
<i>2001</i>	<i>132</i>	<i>26</i>
<i>2000</i>	<i>124</i>	<i>28</i>
<i>1999<sup>4</sup></i>	<i>90</i>	<i>23</i>
1998	82	33
1997	79	33
1996	87	35
1995	64	32
1994	54	27
1993	59	32
1992	71	32
1991	68	30
1990	81	35
1982-1989	627	40

Source: U.S. Consumer Product Safety Commission, Directorate for Epidemiology, Division of Hazard Analysis.

Italics denote the period for which reporting is incomplete.

While the percentage of victims under age 16 appears to have declined since 1998, it is also probable that adult deaths were under-reported during the period 1982 to 1998. Because of coding issues associated with ATV-related fatalities under the old ICD-9 system, CPSC was less able to gather reports of deaths on public roads during those years. If adults were more likely to use ATVs on public roads than children were during that time frame, then deaths of children may appear to have been over-reported. See Appendix B for more discussion of this effect.

<sup>3</sup> Reporting is incomplete for 2002-2005. Percentages for years for which reporting is incomplete should be interpreted with caution because the rate at which deaths are reported may not be consistent across all age groups.

<sup>4</sup> Beginning in 1999, deaths were coded under the Tenth Revision of the International Classification of Diseases (ICD-10). See Appendix B for a discussion of the effect of this change.

Production of three-wheel ATVs ceased in the mid- to late-1980s, and ATVs currently distributed in the U.S. are four-wheel ATVs. The percent of reported fatalities that involved four-wheel ATVs has increased from seven percent or less prior to 1985 to about 88 percent during the 2000s, based on those fatalities reported as of December 31, 2005 (at which time data collection for 2002-2005 was not complete).

#### **Estimated Deaths and Risk of Death, 1985 to 2004**

The deaths reported to the Commission represent a minimum count of ATV-related deaths. To account for deaths not reported to the Commission, estimates of the annual deaths were calculated for 1985 through 2004 using a statistical estimation method. Table 4 shows the annual reported and estimated numbers of ATV-related deaths for ATVs with three, four or an unknown number of wheels, in addition to the annual estimates and risk of death for four-wheel ATVs (per 10,000 in use) from 1985 to 2004.

The heavy line between 1998 and 1999 in Table 4 demarcates the previously discussed switch from data collection under ICD-9 to ICD-10. The ICD-10 transition and the resulting necessary changes in methodology are explained more fully in Appendix B. Because ICD-10 allows CPSC to gather data on more ATV-related deaths on public roads than had been possible under ICD-9, some of the increase in deaths from 1998 to 1999 is probably due to changes in data collection, although the magnitude of the effect of this change is unclear. Such a conclusion would indicate that the death and risk estimates calculated by the pre-1999 methodology were underestimates, though they were the best estimates possible using available data.

Column 5 of Table 4 gives annual estimates for the numbers of four-wheel ATVs in use. According to CPSC staff's *All Terrain Vehicle 2001 Injury and Exposure Studies*, in 2001, about 5.6 million three- and four-wheel ATVs were in use, and about 86 percent of these were four-wheelers (Levenson, 2003a).

A discussion of the methodology used for the calculation of the estimates of the numbers of deaths and the risk of death associated with ATVs is given in Appendix B.



**Table 4**  
**Annual Estimates of ATV-Related Deaths**  
**And Risk of Death for Four-Wheel ATVs**  
**As of December 31, 2005**

<b>Year</b>	<b>Reported Deaths<sup>5</sup></b>	<b>Estimated Deaths Associated With ATVs with 3, 4 or Unknown Wheels</b>	<b>Estimated Deaths Involving 4-Wheel ATVs</b>	<b>Estimated 4-Wheel ATVs in Use (millions)<sup>6</sup></b>	<b>Estimated Risk of Death per 10,000 4-Wheel ATVs In Use</b>
2004	609	767	734	6.9	1.1
2003	636	757	721	6.2	1.2
2002	540	603	566	5.5	1.0
2001	517	593	549	4.9	1.1
2000	451	552	502	4.2	1.2
1999 <sup>7</sup>	398	536	488	3.6	1.4
1998	251	287	245	3.1	0.8
1997	241	291	243	2.7	0.9
1996	248	267	208	2.4	0.9
1995	200	276	212	2.2	1.0
1994	198	244	168	2.0	0.8
1993	183	211	144	1.9	0.7
1992	221	241	158	1.9	0.8
1991	230	255	152	1.8	0.8
1990	234	250	151	1.8	0.9
1989	230	258	153	1.6	0.9
1988	250	286	152	1.4	1.1
1987	264	282	126	1.1	1.1
1986	299	347	95	0.7	1.3
1985	251	295	55	0.4	1.5

Source: U.S. Consumer Product Safety Commission, Directorate for Epidemiology, Division of Hazard Analysis.  
Italics denote the period for which reporting is incomplete.

### **Estimated Hospital Emergency-Room-Treated Injuries**

Table 5 shows estimates of ATV-related injuries treated in hospital emergency rooms nationwide between January 1, 1982 and December 31, 2005. These estimates are generated from CPSC's National Electronic Injury Surveillance System, a probability sample of U.S. hospitals with 24-hour emergency rooms and more than six beds. In this analysis, the current estimates are compared to the estimates from the immediately previous year, as well as to a base year. The base year chosen for

<sup>5</sup> Reporting is incomplete for 2002-2004.

<sup>6</sup> Rounded.

<sup>7</sup> Beginning in 1999, deaths were coded under the Tenth Revision of the International Classification of Diseases (ICD-10). See Appendix B for an explanation of the effect of this change.

comparison was 2001.<sup>8</sup> The existence of a trend in injuries associated with ATVs with three, four or an unknown number of wheels is also considered.

**Table 5**  
**Annual Estimates<sup>9</sup> of ATV-related Emergency-Room-Treated Injuries**  
**ATVs with 3, 4 or Unknown Number of Wheels**  
**January 1, 1982 through December 31, 2005**

<b>Year</b>	<b>Estimated Number of Injuries All Ages</b>	<b>Estimated Number of Injuries Ages Younger Than 16 Years</b>	<b>Percent of Total Ages Younger Than 16 Years</b>
2005	136,700	40,400	30%
2004	136,100	44,700	33
2003	125,500	38,600	31
2002	113,900	37,100	33
2001	110,100	34,300	31
2000	92,200	32,000	35
1999	82,000	27,700	34
1998	67,800	25,100	37
1997	52,800	20,600	39
1996	53,600	20,200	38
1995	52,200	19,300	37
1994	50,800	21,400	42
1993	49,800	17,900	36
1992	58,200	22,000	38
1991	58,100	22,500	39
1990	59,500	22,400	38
1989	70,300	25,700	37
1988	74,600	28,500	38
1987	93,600	38,600	41
1986	106,000	47,600	45
1985	105,700	42,700	40
1984	77,900	<sup>10</sup>	
1983	32,100	<sup>10</sup>	
1982	10,100	<sup>10</sup>	

Source: National Electronic Injury Surveillance System, U.S. Consumer Product Safety Commission.

Note: Coefficients of variation (CVs) for injury estimates for all ages between 1997 and 2005 range from 9 percent to 11 percent. For ages under 16, the CVs of the injury estimates between 1997 and 2005 range from 9 percent to 13 percent. CVs for years prior to 1997 are not available. See Appendix B for an explanation of the use and calculation of CVs.

The injury estimate for all ages for 2005 reflects an increase of less than one percent over the 2004 estimate. This increase was not statistically significant ( $p = 0.8953$ ). However, the increase of 24 percent over the estimated number of injuries in 2001 is a statistically significant increase ( $p = 0.0001$ ).

<sup>8</sup> See the methodology section in Appendix B, p. 18, for a discussion of why 2001 was chosen as the base year.

<sup>9</sup> Estimates have been adjusted to reflect NEISS Coding Manual changes and sampling frame updates. Estimates have also been adjusted by factors to account for cases that are out of scope for this report. Appendix B provides further detail.

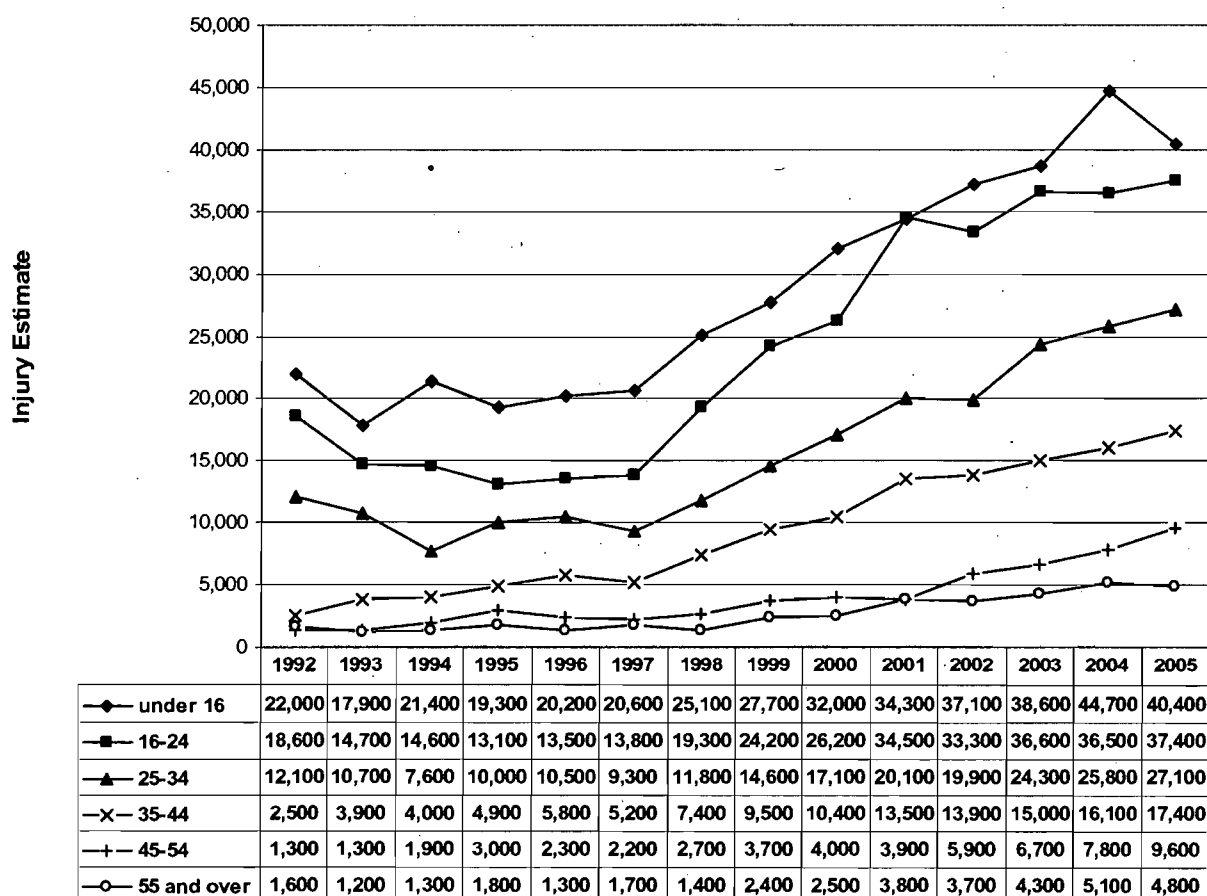
<sup>10</sup> Adjusted estimates for children under 16 years old were not computed prior to 1985.

The 2005 estimate for children under 16 represents a 10 percent decrease over the 2004 estimate. This decrease was not statistically significant ( $p = 0.0703$ ). The 2005 under-16 estimate is an 18 percent increase over the 2001 estimate. This increase was statistically significant ( $p = 0.0410$ ).

Children under 16 years of age accounted for about 30 percent of the estimated number of injuries in 2005. Historically, children under 16 have accounted for about 36 percent of the total estimated number of injuries from 1985 through 2005 inclusive.

Figure 1 presents annual estimates by age group for ATV-related injuries treated in hospital emergency rooms since 1992.

**Figure 1**  
**Annual ATV-Related Injury Estimates<sup>11</sup>**  
**ATVs with 3, 4 or Unknown Number of Wheels**  
**1992-2005**



Source: National Electronic Injury Surveillance System, U.S. Consumer Product Safety Commission.  
Columns may not add to annual totals due to rounding.

In 2005, the estimated number of injuries increased in every age group except the youngest and the oldest. Most changes were not statistically significant. The one exception was the increase in the 45- to

<sup>11</sup> Estimates have been adjusted to reflect NEISS Coding Manual changes and sampling frame updates. Estimates have also been adjusted by factors to account for cases that are out of scope for this report. Appendix B provides further detail.

54-year-old age group, from an estimated 7,800 injuries to an estimated 9,600 injuries. This 24 percent increase was statistically significant ( $p = 0.0426$ ). The next greatest percentage change in the number of injuries occurred in the under-16 age group, which experienced a ten percent decrease, followed by the 35- to 44-year-old age group, which experienced an eight percent increase. The 55-and-over age group underwent a six percent decrease; the 25- to 34-year-old age group saw a five percent increase, and the 16-to 24-year-old age group experienced a two percent increase. None of these, other than the 45- to 54-year-old group's change, was statistically significant.

**Table 6**  
**Estimated Number of Injuries And Risk of Injury**  
**Associated with Four-Wheel ATVs**  
**January 1, 1985 – December 31, 2005**

<b>Year</b>	<b>Injury Estimate<sup>12</sup></b>	<b>Estimated 4-Wheel ATVs in Use (millions)<sup>13</sup></b>	<b>Risk Estimate per 10,000 4-Wheel ATVs in Use</b>
2005	130,000	7.6	171.5
2004	129,500	6.9	187.9
2003	116,600	6.2	188.4
2002	104,800	5.5	190.0
2001	98,200	4.9	200.9
2000	82,300	4.2	197.2
1999	68,900	3.6	193.0
1998	57,100	3.1	184.7
1997	39,700	2.7	146.1
1996	40,700	2.4	168.1
1995	36,200	2.2	165.7
1994	33,300	2.0	165.4
1993	32,000	1.9	164.9
1992	33,000	1.9	175.1
1991	34,400	1.8	188.1
1990	30,800	1.8	175.1
1989	35,700	1.6	217.8
1988	39,400	1.4	276.1
1987	33,900	1.1	305.9
1986	23,400	0.7	319.2
1985	14,700	0.4	391.1

Source: U.S. Consumer Product Safety Commission, Directorate for Epidemiology, Division of Hazard Analysis; National Electronic Injury Surveillance System; and the Directorate for Economic Analysis.

Note: Coefficients of variation (CVs) for four-wheel ATV estimates for the years 1997 to 2005 range from 8.7 percent to 10.5 percent. CVs for estimates in column 3 of this table for the years 2001 to 2005 range from 3.2 percent to 3.8 percent. CVs for estimates in column 4 for the years 2001 to 2005 range from 9.3 percent to 10.0 percent (Levenson, 2005b and 2005c). CVs for years prior to 2001 for columns 3 and 4 are not available.

<sup>12</sup> Estimates have been adjusted to reflect NEISS Coding Manual changes and sampling frame updates. Estimates have also been adjusted by factors to account for cases that are out of scope for this report. Appendix B provides further detail.

<sup>13</sup> Rounded.

Table 6 shows estimates of four-wheel ATV-related injuries and risk of injury for January 1, 1985 through December 31, 2005. Four-wheel injuries constituted 95 percent of the total estimate for ATVs with three, four or an unknown number of wheels in 2005. The injury estimate for 2005 represents an increase of less than one percent over the estimate for 2004 and is not a statistically significant increase ( $p = 0.9301$ ). It is, however, a statistically significant increase over the estimate for 2001 ( $p < 0.0001$ ). There was a statistically significant upward trend in injuries ( $p = 0.0159$ ) associated with four-wheel ATVs between 2001 and 2005.

In Table 6 risk is defined as the estimated number of injuries divided by the number of vehicles in use, multiplied by 10,000. There was no statistically significant trend, positive or negative, in injury risk from 2001 to 2005, the years for which the necessary data for testing is available ( $p = 0.1075$ ).

## **Discussion**

In analyzing deaths and injuries associated with ATVs, it is useful to consider three distinct periods, the boundaries of which are determined by changes in CPSC's data collection abilities. By considering these three periods separately, we can compare years within periods, thereby controlling for changes in data collection abilities or effects of external factors. While the boundaries of the periods considered here will be defined for convenience by factors involving the collection of death data, it is also useful to consider the injury estimates within the same periods and their relationship to the death estimates.

The first period, from 1982 to 1998, started when CPSC began calculating estimates of deaths associated with ATVs and ended at the transition from the use of ICD-9 for classification of deaths to ICD-10. This transition is discussed in the methodology section of this report (Appendix B). While not by design, this period contains the years in which the Consent Decrees were in effect. The second period, from 1999 to 2001, began with the transition to ICD-10. The second period ended at the last complete year of death data collection, which is currently 2001. The third period, from 2002 to 2005, spans the period of incomplete data collection for deaths to the present. The third period also begins with the year that the Consumer Federation of America petitioned CPSC to ban the sale of adult-sized ATVs for use by children under 16. During this period CPSC also issued an Advance Notice of Proposed Rulemaking and a Notice of Proposed Rulemaking on ATVs. One result of these events has been an increase in media attention to deaths associated with ATVs, thus increasing CPSC's ability to gather death reports.

During the first period (1982 to 1998), reported deaths reached a high of 299 in 1986. Reported deaths that year were mostly deaths associated with three-wheel ATVs, which were still being manufactured and sold. The estimated number of injuries associated with ATVs (with three, four or an unknown number of wheels) rose above 100,000 for the first times in 1985 and 1986. The estimated number of deaths on four-wheel ATVs was relatively low in the earlier half of this period, probably because three-wheel ATVs were still heavily in use and four-wheelers were only beginning to gain in popularity.

CPSC's ability to gather reports of deaths during the first period was limited by certain ICD-9 reporting requirements (see Appendix B). Because of this, the estimated numbers of deaths in the first period were likely underestimates. However, general upward or downward directions may still be evident even with underestimates if the underestimation was fairly constant from year to year. It is likely that the estimated numbers of deaths in the first period were in fact underestimated each year by the same amount. Factors contributing to this are discussed below.

The ICD-9 reporting requirements made it difficult for CPSC to purchase death certificates from the states for deaths associated with ATVs occurring on public roads. If ATV fatalities were more likely to have occurred on a public road than in a private location in (for example) 1997 than in 1991, then the estimates for the two years would not have been equally underestimated. Likewise, if deaths of four-wheel ATV riders were more likely to occur on public roads than deaths of three-wheel ATV riders, then estimates for the two years would not have been equally underestimated. We have no reason to believe that either of these factors was present (nor any other factor influencing underestimation other than ICD-9) in the first period.

Because data collection was substantially constant in methodology throughout the first period, relative comparisons among the annual estimated numbers of deaths within the first period can be made with caution. For instance, we note that it is likely that the estimated number of deaths associated with three, four or an unknown number of wheels peaked around 1986 and experienced a low point around 1993 during the first period. Similarly, a general increase may be noted in the estimated deaths associated with four-wheel ATVs from around 1993 to the end of the period. Note that these generalizations do not require a discussion of the magnitude of the estimates.<sup>14</sup>

A similar pattern of peaks and valleys occurred with the estimated number of injuries associated with ATVs with three, four or an unknown number of wheels during the first period, suggesting that the pattern seen in the estimated number of deaths is not an artifact of the data.

The second period (1999 to 2001) contains three years in which CPSC had unparalleled opportunities to collect comprehensive death data on ATVs. It also predated the 2002 petition from the Consumer Federation of America and CPSC's recent rulemaking activities. Consequently, the effect of increased media exposure of the ATV issue on data collection was not in play during the second period, as it is during the third period. Reported deaths increased by 30 percent during the second period. The estimated numbers of injuries associated with three, four or an unknown number of wheels during this period are part of a larger increasing trend from 1998 to 2005, but there are yearly significant increases within the second period as well.

The third period (2002 to 2005) contains four years of incomplete death data collection. Because the number of reported deaths for these years will likely increase and the estimated numbers of deaths and the estimated risk of death will change in future reports, conclusions using these estimates from the third period should be made with caution. The injury estimates in the third period for both ATVs associated with three, four or an unknown number of wheels and for four-wheel ATVs alone – for which data collection is complete – are high. However, analysis has demonstrated that there is no statistically upward or downward trend in the risk of injury from 2001 to 2005 (the years for which the necessary data are available).

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<sup>14</sup> The reader is cautioned against making similar generalizations regarding the estimated number of ATVs in use and the estimated risk of death, since these estimates may be subject to sources of error other than those mentioned here.

## Appendix A

**Table 7**  
**Reported ATV-Related Deaths by Year and Age Group**  
**ATVs with 3, 4 or Unknown Number of Wheels**  
**January 1, 1982 to December 31, 2005**

<b>Year<sup>15</sup></b>	<b>Younger Than 12 Years Old</b>	<b>Younger Than 12 Years Old Percent of Total</b>	<b>Younger Than 16 Years Old</b>	<b>Younger Than 16 Years Old Percent of Total</b>
<b>Total</b>	<b>917</b>	<b>13%</b>	<b>2,178</b>	<b>30%</b>
<i>2005</i>	<i>57</i>	<i>12</i>	<i>120</i>	<i>26</i>
<i>2004</i>	<i>59</i>	<i>10</i>	<i>155</i>	<i>25</i>
<i>2003</i>	<i>67</i>	<i>11</i>	<i>152</i>	<i>24</i>
<i>2002</i>	<i>45</i>	<i>8</i>	<i>133</i>	<i>25</i>
<i>2001</i>	<i>58</i>	<i>11</i>	<i>132</i>	<i>26</i>
<i>2000</i>	<i>50</i>	<i>11</i>	<i>124</i>	<i>27</i>
<i>1999<sup>16</sup></i>	<i>34</i>	<i>9</i>	<i>90</i>	<i>23</i>
<i>1998</i>	<i>30</i>	<i>12</i>	<i>82</i>	<i>33</i>
<i>1997</i>	<i>38</i>	<i>16</i>	<i>79</i>	<i>33</i>
<i>1996</i>	<i>40</i>	<i>16</i>	<i>87</i>	<i>35</i>
<i>1995</i>	<i>26</i>	<i>13</i>	<i>64</i>	<i>32</i>
<i>1994</i>	<i>20</i>	<i>10</i>	<i>54</i>	<i>27</i>
<i>1993</i>	<i>18</i>	<i>10</i>	<i>59</i>	<i>32</i>
<i>1992</i>	<i>32</i>	<i>14</i>	<i>71</i>	<i>32</i>
<i>1991</i>	<i>40</i>	<i>17</i>	<i>68</i>	<i>30</i>
<i>1990</i>	<i>27</i>	<i>12</i>	<i>81</i>	<i>35</i>
<i>1982-1989</i>	<i>276</i>	<i>18</i>	<i>627</i>	<i>40</i>

Source: U.S. Consumer Product Safety Commission, Directorate for Epidemiology, Division of Hazard Analysis.  
Italics denote the period for which reporting is incomplete.

<sup>15</sup> Reporting is incomplete for 2002-2005. Percentages for years for which reporting is incomplete should be interpreted with caution because the rate at which deaths are reported may not be consistent across all age groups.

<sup>16</sup> Beginning in 1999, deaths were coded under the Tenth Revision of the International Classification of Diseases (ICD-10). See Appendix B for a discussion of the effect of this change.

## Appendix B

### Methodology

#### Deaths

CPSC staff estimates the number of deaths associated with ATVs by use of a capture-recapture approach. This approach involves examining the numbers of reports of fatalities gathered by two different methods. The first method is the collection of death certificates purchased from the states, where the death was deemed ATV-related by the medical examiner. These incidents are entered into CPSC's death certificate database (DTHS). The second method is the collection of various types of reports of fatal ATV-related incidents by any other means available to the agency: news clips, reports from the Medical Examiners' and Coroners' Alert Project (MECAP), reports from consumers via phone or Internet, hospital reports from the National Electronic Injury Surveillance System (NEISS), as well as other types of reports.

Column 3 in Table 1 in the body of the report presents counts of deaths reported to CPSC that have not been reported in previous years. Additional fatality reports that are duplicates of ones counted in previous versions of this annual report may have been received (e.g., CPSC may have received a news clip about a death that originally was reported via a MECAP report in a prior year). Counts of these duplicate reports are not included in Table 1.

The calculation of the capture-recapture estimate entails examining the number of incidents included in DTHS or from non-DTHS sources as well as the number included on both lists of incidents. The estimate is given by<sup>17</sup>

$$\text{estimate} = \frac{(M+1)(N+1)}{n+1} - 1 \quad \text{Formula 1}$$

where

*M* is the number of incidents captured by purchase of death certificates from the states,

*N* is the number of incidents collected by other means, and

*n* is the number of incidents captured by both death certificate purchase and by at least one other source.

Estimates of fatalities occurring on or after January 1, 1999 that were associated with ATVs with three, four or an unknown number of wheels were calculated using formula 1.

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<sup>17</sup> Hook, E.B. and Regal, R.R. The Value of Capture-Recapture Methods Even for Apparent Exhaustive Surveys. American Journal of Epidemiology. 1992;135(9):1060-1067.



In 1999, CPSC began collecting death certificates of all fatalities involving an ATV, as coded under the Tenth Revision of the International Classification of Diseases (ICD-10). ICD-10 marks the first revision for which all ATV-related fatalities are grouped under a single code, thus facilitating more complete collection of these incidents by CPSC than was accomplished prior to 1999.

Prior to 1999, CPSC received death certificates only of fatalities occurring in places other than public roads and of fatalities occurring in public road locations that were erroneously reported as non-public-road locations. Because of this, the procedure for estimating ATV-related deaths had two parts. Because death certificates generally were not collected for public road fatalities, the count for these fatalities was the number of reports received, mostly in the Injury or Potential Injury Incident file (IPII). For incidents occurring in other places, the capture-recapture approach was applied. The two parts (incidents occurring on public roads and incidents occurring in other places) were then combined for the annual estimate of deaths, as in the following formula:

$$estimate = \frac{(M_{NP} + 1)(N_{NP} + 1)}{n_{NP} + 1} - 1 + C_p \quad \text{Formula 2}$$

where

$M_{NP}$  is the number of reports of non-public-road fatalities captured by purchase of death certificates from the states,

$N_{NP}$  is the number of reports of non-public-road fatalities collected by other means,

$n_{NP}$  is the number of reports of non-public-road fatalities captured by both death certificate purchase and by at least one other source,

and

$C_p$  is the count of reports of ATV-related fatalities occurring on public roads from any source.

CPSC staff believes estimates for years prior to 1999 to be underestimates because those estimates used only the available count of public road fatalities, and did not account for missing reports. Since CPSC now receives death certificates for ATV incidents occurring anywhere, the capture-recapture approach has been utilized for the entire estimate of ATV-related deaths from 1999 forward. The resulting estimates of deaths after January 1, 1999 represent a better approximation of the number of deaths associated with ATVs.

A number of incidents reported to CPSC involve ATVs for which the number of wheels is unknown. Because some of these likely involve four-wheel ATVs, the unknowns are apportioned in the calculation of the estimated number of deaths associated with four-wheelers. This estimate was calculated by first dividing the reported number of deaths for four-wheel ATVs by the combined reported number of deaths for three- and four-wheel ATVs, then multiplying this quotient by the estimated number of deaths for all ATVs (three, four or unknown number of wheels). Thus, the estimate of deaths associated with four-wheel ATVs is given by

$$Estimate_{4W} = \frac{rep_{4W}}{rep_{3W+4W}} Est_{3W+4W+UW} \quad \text{Formula 3}$$

where

$Estimate_{4W}$  is the estimated number of fatalities associated with four-wheel ATVs,  
 $rep_{4W}$  is the reported number of fatalities associated with four-wheel ATVs,  
 $rep_{3W+4W}$  is the reported number of fatalities associated with three- and four-wheel ATVs,  
and

$Est_{3W+4W+UW}$  is the estimated number of fatalities associated with ATVs with three, four or an unknown number of wheels.

The risk of death associated with four-wheel ATVs was calculated by dividing the annual estimate of fatalities associated with four-wheel ATVs ( $Estimate_{4W}$ ) by the estimated number of ATVs in use in a given year. Annual estimates of the numbers of ATVs in use were determined from ATV sales and operability rates based on exposure studies conducted by industry.<sup>18</sup> Annual ATVs-in-use estimates for 1994 and prior years were computed from a survival model derived from 1994 data. Annual ATVs-in-use estimates for years 2001 and after were computed from a survival model derived from 2001 data. Estimates of the annual numbers of in-use ATVs for the intervening years came from a model that provided a smooth transition between the 1994 and the 2001 models. The estimated numbers of four-wheel ATVs in use in Tables 4 and 6 are rounded figures. Risk estimates calculated using these rounded figures may not match those in the tables because of this.

Because reliable operability rate data are not available for three-wheel ATVs, the risk of death is given in this report only for four-wheel ATVs.

Fatal incidents considered in-scope in this report include any unintentional incident involving an ATV, whether or not the ATV was in operation at the time of the incident. Because of the difficulties inherent in distinguishing between occupational and non-occupational use, occupational fatalities are included when reported to CPSC. For instance, a fatality that occurs when a victim is riding alongside a fence on a ranch for the purpose of checking it and then overturns his ATV while deviating from his usual work routine to take a "joy ride" up a nearby hill may be difficult to classify. In addition, ATVs are primarily recreational products, and the relative proportion of occupational fatalities in this report is small.

### Injuries

All injury estimates in this report were derived from data collected through CPSC's National Electronic Injury Surveillance System, a probability sample of U.S. hospitals with 24-hour emergency rooms and more than six beds (Schroeder and Ault, 2001a and 2001b). Estimates have been adjusted due to revisions in the NEISS Coding Manual in 1985, as well as to account for NEISS sampling frame updates (Marker, et al, 1988; Marker and Lo, 1996). Estimates for 1982 through 1985 were adjusted based on a review of NEISS comments to exclude dune buggies and identify ATVs classified as mini or trail bikes.

Injury estimates for 1985, 1989, 1997 and 2001 are based on injury surveys using NEISS cases. Injury estimates for other years have been adjusted by factors to account for out-of-scope (non-ATV) cases

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<sup>18</sup> See Levenson, M., 2001 ATV Operability Rate Analysis, memorandum. May 6, 2003. U.S. Consumer Product Safety Commission. Also see Levenson, M. *All-Terrain Vehicle 2001 Injury and Exposure Studies*. January 2003. U.S. Consumer Product Safety Commission.

based on injury studies in those years (Levenson, 2003c; Rodgers and Zamula, 1986; Rodgers, 1990; U.S. CPSC, 1998). An in-scope case was defined to be any non-occupational, unintentional case involving an ATV, whether or not the victim was operating the ATV at the time of the incident. (NEISS does not collect occupational injuries.) The adjustment factors were 0.93 for 1986 through 1988, 0.95 for 1990 through 1996, 0.903 for 1998 through 2000 (amended from 0.935) and 0.922 for 2002 and after.

A coefficient of variation (or CV) is an expression of the standard deviation relative to the estimate itself. In this report CVs for injury estimates are given as percents. The adjustment factors discussed above are also estimated and have associated variability. This variability (along with the variability of the injury estimates) affects significance tests and tests for trends. Calculation of NEISS estimates and their variances is discussed in Schroeder and Ault 2001a and Schroeder and Ault 2001b. Adjustment factors and other concepts specific to variability associated with ATV estimates are more fully discussed in Levenson 2003b and Levenson 2005c.

NEISS includes incidents associated with ATVs for which the number of wheels is unknown. Because of this, the unknowns are apportioned in the calculation of the estimated injuries associated with four-wheelers. The four-wheel calculation was accomplished by the following formula:

$$Total\ Estimate_{4W} = \frac{Estimate_{4W}}{Estimate_{3W+4W}} (Estimate_{3W+4W+UW}) \quad Formula\ 4$$

where

*Total Estimate<sub>4W</sub>* is the total estimated injuries associated with four-wheel ATVs with unknowns apportioned,

*Estimate<sub>4W</sub>* is the estimated injuries associated with four-wheel ATVs not including unknowns,

*Estimate<sub>3W+4W</sub>* is the combined estimated injuries associated with three- and four-wheel ATVs (not including unknowns),

*Estimate<sub>3W+4W+UW</sub>* is the combined estimated injuries associated with ATVs with three, four or an unknown number of wheels.

Risk of injury in this report is defined as the estimated number of injuries divided by the number of vehicles in use, multiplied by 10,000. Annual ATV population estimates were the same as those used in the calculation of risk of death and are discussed elsewhere in this appendix. Trend analysis of the risk of injury follows the methodology discussed in section 4 of Levenson 2005b.

Changes in the injury estimates given in Table 5 were tested using a base year of 2001. This base year was chosen because data from 2001 may reflect the current ATV market more accurately than older data. Certain features of the current market may make comparisons across recent time spans more meaningful. The use of 2001 to assess changes and trends in injury estimates was also chosen because it is consistent with the use of 2001 to assess injury risk. The year 2001 is used to assess changes in injury risk because of the availability of sales and operability data.

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